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Modular Gripper

The object of the invention presented here is a gripper provided with air chokes using vacuum suction, capable of transporting various materials or objects, in particular, made of metal, cardboard, glass, wood in all types of industries.

The manufacture of these grippers is generally performed in a non-industrial manner, differing according to the industrial environment, often out of welded steel tubes, always at the last minute, from a prototype of the piece to be transported, and designed by the maintenance departments of factories.

Grippers of this type are known, for example, from the patent FR-A 2 566 310 and from the patent EP 0 802 334. The standardization of these grippers is not a priority and is not the object of research as far as productivity is concerned.

The gripper intended by the invention has the purpose of correcting these disadvantages.

According to the invention, the gripper consists of the characteristics according to claim 1.

Based on these characteristics, a prototype of the piece to be transported is no longer necessary, since the gripper can be designed from a digitized tape of the piece. The sizeable number of standard pieces makes it possible to assemble it in only about ten minutes by virtue of its modularity. In addition, adjustment can be done in three dimensions. In this way, it is possible to grip pieces having awkward and complex shapes.

According to the invention, the gripper also consists of the characteristics of the claims 2 to 12.

The invention will be described in reference to the attached drawings which show it in possible different embodiment modes.

Figure 1 is a perspective view of an embodiment form of a modular gripper according to the invention.

Figures 2 and 3 are transverse section views of the profile sections that can constitute a central core of the gripper according to the invention.

Figure 4 is a transverse section view of a profile section that can be attached perpendicularly to the central core of the gripper.

Figure 5 is a perspective view of a joint for attachment of a profile section to the central core.

Figure 6 is a perspective view of an angle bracket for attachment of a profile section to the central core.

Figure 7 is a perspective view of a ball and socket bearing.

Figure 8 is a perspective view of a ball joint.

Figure 9 is a longitudinal section view of a ball joint fitted with a spring according to a second embodiment mode.

Figure 10 shows a ball and socket bearing equipped with an air choke.

Figures 11 and 12 show an extension piece and a sloped shim, respectively.

Figure 13 shows a small plate;

Figure 14 and 15 are perspective views of the manual interfaces between the gripper and a robot or mechanized system (not shown).

Figure 16 is a sectional front view of a ball joint fitted with a spring, of its air choke and its bearing.

Figure 17 is a front view of a flat angle mounting bracket.

Figure 18 is a transverse section view of a profile section core of the gripper.

Figure 19 is a perspective and partial section view of the profile section core, of a ball and socket bearing, of a ball joint fitted with a spring, and the associated air choke.

Figure 20 is view similar to Figure 19 according to another embodiment form of the ball joint.

Figure 21 is a front view similar to Figure 20 showing another embodiment variation.

Figure 22 is a perspective view of a manual interface between the gripper and a robot.

Figures 23 to 25 are perspective views of automatic interfaces between the modular gripper according to the invention and a robot or an automated system (not shown).

Figure 26 is a perspective view of a crosspiece equipped with three interfaces with grippers according to the invention.

Figure 27 is a front view of a ball joint combined with an extension piece.

Figures 28 and 29 show plates for arms bent at an angle vertically.

Figure 30 is a perspective view in a reduced scale of a gripper equipped with plates of Figures 28 and 29.

Figures 31 and 32 show plates for arms bent at angle horizontally.

Figure 33 is a perspective view in a reduced scale of a gripper equipped with plates of Figures 31 and 32.

The gripper shown in the drawings is made of a modular structure, which consists of a central profile section core (Fig. 2) whose dimensions are fitted to the size of the piece to be transported, and of a profile section (Fig. 4) fitted in order to be attached perpendicularly onto this central core.

Two lateral grooves 10, 20 of the profile section of Figure 4 make it possible to clamp there, on each side, a pipe, for example, of the size 5.5 x 8. The same possibility exists for opposed lateral grooves 30, 40 and 50, 60 of the profile sections of Figures 2 and 3, whose geometry can be modified approximately in order to allow the grooves 30, 40, 50, 60 to clamp 5.5 x 8 pipes there from two sides.

The gripper also consists of mechanisms for affixing these profile sections at the selected location, ball and socket bearings mounted at the ends of these profile sections (Fig. 7 to 10), air chokes that are affixed to the ends of the ball joints (Fig. 10, 16 and 21) and ball joints that enable an angular clearance of the air chokes.

The central core can be made of aluminum. The attachment system consists of a connection piece (Fig. 5) and angle brackets (Fig. 6); it makes it possible to easily adjust the different profile sections of Fig. 4 to the selected location. The length of the profile sections of Fig. 4 is determined by the position of the air chokes that, themselves, vary according to the geometry of the piece to be transported.

At the end of the profile sections of Fig. 4, ball and socket bearings are affixed (Fig. 7, profile plane of Fig. 17) on which simple ball joints (Fig. 8) or ball joints fitted with springs (Fig. 9) or combined ball joints (Fig. 27) are mounted as needed. The mounting of all of the elements is shown in Figures 10, 16, and 21. The ball and socket bearings (Fig. 7) are affixed onto the profile section of Fig. 4 by the small plates (Fig. 13) that slide inside of it, and which make thus it possible to provide a supplemental adjustment.

The two different types of ball joints (Fig. 8 and 9) make possible an angular clearance of approximately + 22 degrees, which makes it possible to refine the final adjustment. The combined ball joints (Fig. 27) allow an angular clearance of approximately + 30 degrees, and, depending on their length, act simultaneously as an extension. The different types of air chokes are chosen as a function of the space available on the piece to be transported and its weight. There are affixed to the end of the ball joints (Fig. 10, 16 and 21).

In case it is necessary to adjust the height, there are several types of extension pieces (Fig. 11) or combined ball joints covering most of the necessary adjustments. In case of awkward pieces that require an angular clearance greater than the one obtained with the ball and socket bearings (Fig.7) and the ball joints (Fig. 8, 9), as well as the combined ball joints, sloped shims are planned (Fig. 12) that make it possible to increase the angle by 15 degrees in one case and 35 degrees in the other case.

The assembly of all of these pieces makes it possible to construct a modular gripper that is capable of meeting all requirements. The specifically designed shapes of the profile sections, as well as the standard assembly of the pieces made of a light metal alloy, make it possible to obtain an assembly having a large amount of rigidity with a relatively low weight. On the three types of profile sections, shapes have been specifically designed in order to clamp two types of suction pipe, which produce a gain in assembly time, and which make it unnecessary to affix them with pipe-collars (see Figure 18). All three have been designed in order to receive the small mounting plate (Fig. 13), which makes it possible to only keep in stock a single small plate reference item, and to obtain a good quality of clamping in the profile sections 30. The inside hole of the

profile sections is designed in a manner to be directly threaded in ISO pitches without the necessity for machining.

The modular gripper according to the invention can be affixed onto a robot or onto a mechanized system with the help of a manual interface that is specially adapted for this purpose (Fig. 14 and 15) for the profile sections of Figures 2, 22, and 3. It is also possible to make automatic interfaces for the profile section of Figure 2 (Fig. 23 and 24), and for the profile section of Figure 3 (Fig. 25).

The interfaces, by virtue of their monostable clamping at a corner cam of the profile section, allow in all cases a large amount of clamping rigidity and a good repeatability of the positioning precision of the modular gripper.

The profile section made of aluminum in Figures 2 and 3 has a structure whose shapes have been specifically designed in order to obtain an especially low weight, all while preserving an especially good resistance to torsion and to deflection. Moreover, on two opposite sides of the profile section of Fig. 2, the diameter of the shapes and the width of the intake groove provide the possibility for clamping on one side, a 5.5 x 8 suction pipe, and on the other side, a 4 x 6 suction pipe (see Fig. 18).

In addition, on the two other sides, the shapes of the slides make it possible to mount the small mounting plates (Fig. 13) which are common to the profile section of Fig. 3 and to the profile section of Fig. 4. This has the consequence that only a single small plate reference item needs to be kept in stock (Fig. 13) and that a good clamping coupling is obtained since a good installation of the screw is made. The diameter of the inside hole of the profile section is provided in order to be tapped directly without additional drilling.

The different attachment pieces (connection piece of Fig. 5, angle bracket of Fig. 6, small plate of Fig. 13) make it possible for the profile section of Fig. 4 to attach at any position selected along the central core, comprised of the profile section of Fig. 2 or of the one from Fig. 3. The air choke is supported by a piece in the form of a ball joint (Fig. 8) that, once mounted in the ball and socket bearing (Fig. 7, gives the assembly an angular clearance of + 22 degrees, thus making it possible to transport pieces with awkward shapes and to refine the adjustments at the last minute (Fig. 10).

The extension pieces (Fig. 11) allow the air chokes to be able to suction by vacuum pieces whose shapes or differences height are sizeable. The automatic interface of Fig. 23 and 24 is provided for the section of Fig. 2, while the automatic interface of Fig. 25 is provided for the section of Fig. 3.

The design of these interfaces makes possible an effective clamping of the modular gripper by irreversible cam clamping and thus a large amount of clamping rigidity. Moreover, it ensures a good repeatability of the mounting precision, because the clamping is done on the sections, enabling an interchangeability of the grippers in a few seconds.

The modular gripper can be mounted on a crosspiece (Fig. 26) that itself is mounted either onto a robot or onto a mechanized system. This crosspiece accommodates three interfaces specified according to the requirements. This system makes it possible to mount a gripper in the center when small pieces are to be transported, or one to each end for pieces having large dimensions. The specifically designed shapes of the crosspiece allow it to be light while maintaining a good rigidity and while limiting vibrations.

Figures 28 and 29 show plates for arms bent horizontally that can equip a gripper (Fig. 30). They make it possible to split the central core of the gripper by 60 degrees. They are assembled in a pair: one in the groove of a profile section 4/6 and the other in that of 6/8.

Figures 31 and 32 show plates for arms bent vertically, for sections of 50 x 50 (Fig. 31) or 40 x 40 (Fig. 32). These plates, according to their height, function to move the gripper of the piece to be transported in the direction of the height.